

REMARKS

No amendments have been made to this application. Accordingly, claims 1-21 remain pending. In view of the following remarks, Applicants respectfully request reconsideration of the outstanding rejections and allowance of pending claims 1-21.

Claims 1, 10, 11, and 21 stand rejected under 35 U.S.C. 102(b) for anticipation by United States Patent No. 5,297,642 to Li et al. This rejection is traversed.

Li is directed to thin film assemblies or devices and particularly thin film assemblies or devices useful as sensors, nonlinear optical materials, and trace material scavengers. *Li*, 1:6-10, 1:55-64. The film assemblies include a base substrate having an oxide surface layer and successive monolayers built up on the substrate. The first of these monolayers appears to be bound to the oxide surface layer of the substrate, and is referred to as a linking group. *Li*, 3:40-42. Li suggests that the base substrate can be composed of a variety of materials, such as quartz, silicon, titanium oxide, and zinc oxide, and the base substrate can generally be any suitable shape or configuration, e.g., solid sheet or film, powder, or fiber. *Li*, 3:28-39. However, the examples of Li are limited to a fused quartz substrate that is repeatedly submersed in different organic chemicals in order to form various monolayers thereon.

Claim 1 of the present invention is directed to a soluble metal oxide while claim 11 is directed to a soluble mixed metal oxide comprising the soluble metal oxide of claim 1. The soluble metal oxide of claim 1 comprises one or more metal oxide crystalline particles with an inner organic binding group attached to at least one metal moiety of the crystalline particle and an outer organic binding group attached to at least one inner organic binding group. As defined in the claims, the one or more metal oxide crystalline particles including such binding groups form a metal oxide that is soluble.

On the other hand, the thin film layers produced by depositing monolayers on a base substrate in Li are, inherently, not soluble. For instance, the fused quartz substrate described in the examples of Li would not, by itself, be soluble. Functionalizing the fused quartz substrate with a monolayer linker group having, for instance, a porphyrin attached thereto will not cause the fused quartz substrate to become soluble. Rather, as Li makes clear throughout, the addition of monolayers provides thin film assemblies or devices capable of acting as a sensor or scavenger rather than metal oxides that are soluble.

While other substrate materials other than quartz are briefly suggested in Li, (e.g., titanium oxide and zinc oxide), there is absolutely no discussion on manufacturing a soluble compound from these materials. In fact, there is no discussion on binding a monolayer linker group to a substrate of titanium oxide or zinc oxide. Accordingly, Li suggests that modification of a base substrate composed of titanium oxide or zinc oxide, each of which would be inherently insoluble, with a monolayer linker group having a porphyrin attached thereto is solely to create a sensing or scavenging device rather than to create a metal oxide that is soluble.

Therefore, Li fails to teach a soluble metal oxide according to claim 1 or a soluble mixed metal oxide according to claim 11 and the rejection of claims 1, 10 and 11 under 102(b) for anticipation by Li should be reconsidered and withdrawn.

Claims 1-9 and 11-20 stand rejected under 35 U.S.C. 102(e) for anticipation by United States Patent No. 6,986,943 to Cook et al. This rejection is traversed.

Cook is directed to surface modified particles and a multi-step modification process for preparing these particles. The particles have a surface shell comprising at least 5% of aluminum oxyhydroxide, iron oxyhydroxide, scandium oxyhydroxide, a solid solution of aluminum oxyhydroxide and iron oxyhydroxide, clay, or mixtures thereof. *Cook*, 5:10-15. The core of the particles may be identical to or different than the shell. *Cook*, 5:15-16. Some examples of "core" materials include metals, inorganic oxides, inorganic oxyhydroxides, inorganic hydrates, and inorganic salts. *Cook*, 6:27-44. However, regardless of the core material the shell material appears to be limited to those indicated above. For instance, while Example 3 of Cook discloses an α -alumina particle, the outer alumina surface is converted to boehmite and then the boehmite surface layer is modified. It is not believed alumina can be subject to the surface modification process of Cook without first converting the outer surface to boehmite.

The modification method disclosed in Cook is essentially a surface modification of oxyhydroxides, and particularly boehmite (also known as aluminum oxyhydroxide, $\text{AlO}(\text{OH})$). The method of modification consists of two steps, the first of which attaches a compound having an anchoring group, which binds to the oxyhydroxide surface, and a functional group that is available for subsequent reactions. *Cook*, 3:35-47. The second step attaches a second reactive group to the previous attached compound. *Cook*, 47-51. Additional steps can be carried out to add additional compounds to the particle. *Cook*, 3:58-59. Of the 20 Examples of

Cook, 18 pertain to the addition of compounds to a particle having a boehmite surface. The remaining examples relate to surface modification of a montmorillonite compound (which is a clay material that is essentially a silicate hydroxide) and a lepidocrocite compound (which is an iron hydroxyoxide).

Cook is not directed to modification of metal oxide crystalline particles with inner and outer binding groups or the production of a soluble metal oxide. Indeed, Cook is not truly directed to metal oxides at all. The only real mention of metal oxides in Cook relates to the composition of the core of the compounds. However, the modified particles in Cook have a core-shell arrangement. *Cook*, 5:15-17. While the core may comprise, for example, inorganic oxides, the shell cannot, and must instead be composed of an oxyhydroxide, clay, or mixtures thereof. *Cook*, 5:10-15. For instance, in an embodiment where the core is aluminum oxide, the shell is aluminum oxyhydroxide. *Cook*, 6:33-38. Furthermore, the preferred embodiments of the anchor compound are selected based on whether the shell particle is an oxyhydroxide or a clay. *Cook*, 7:28-38. Thus, the shell of the particles in Cook, which is where the actual surface modification occurs, is composed of oxyhydroxides or clay. Even assuming the core of the particles in Cook do include a metal oxide, the anchor compounds (Compound A) do not attach to the moieties of the metal oxide because binding of the anchor compounds occurs at the shell, rather than at the core.

A "metal oxide" would be understood by one skilled in the art as a binary oxygen compound containing a metal cation and an oxide anion. Oxyhydroxide compounds are not metal oxides. For instance, the chemical formula for aluminum oxyhydroxide (boehmite) is $\text{AlO}(\text{OH})$ and the chemical formula for lepidocrocite (an iron hydroxyoxide) is $\gamma\text{-FeO}(\text{OH})$. The structure of these oxyhydroxides, such as boehmite, significantly differs from that of metal oxides. Boehmite, for example, is known to possess a corrugated layer structure with hydroxyl groups (O-H) exposed on each side of the individual layers. The hydroxyl groups of adjacent corrugated layers form O-H-O hydrogen bonds with each crucial to the structural, physical and chemical characteristics of boehmite, such as the strength, reactivity and solubility. Given that metal oxides are widely considered to be binary in nature (i.e. possess only metal cations and oxygen anions) the core structure of metal oxides is inherently void of interlayer hydrogen bonding. Hydrous metal oxides, examples of which are discussed in the present invention,

possess the same core structure of anhydrous metal oxides but have a number of hydroxyl and water groups bound to the surface metal atoms only.

Thus, Cook does not anticipate the subject application which is directed to soluble metal oxides (or mixed metal oxides) comprising one or more metal oxide crystalline particles. Cook is instead directed to oxyhydroxide particles such as boehmite, silicates and clays, and surface modification thereof. No mention of surface modification of metal oxides so as to create soluble metal oxides is made in Cook. Instead, Cook merely teaches surface modification of specific oxyhydroxide sites. The present invention is directed to a metal oxide that is rendered soluble by attaching an inner organic binding group to at least one metal moiety of a metal oxide crystalline particle and an outer organic binding group to at least one inner organic binding group to render the metal oxide soluble. This is not taught in Cook and thus Cook fails to anticipate the invention.

Therefore, the rejection of claims 1-9 and 11-20 under 35 U.S.C. 102(e) for anticipation by Cook should be reconsidered and withdrawn.

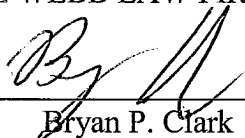
CONCLUSION

For the foregoing reasons, Applicants submit that the pending claims are patentable over the cited documents of record and are in condition for allowance. Accordingly, reconsideration of the outstanding rejection and allowance of pending claims 1-21 are respectfully requested.

Respectfully submitted,

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